U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE

HEARING CHARTER

GAO Report on NOAA's Weather Satellite Program

September 29, 2006
10:00 a.m. to 12:00 p.m.
2318 Rayburn House Office Building

Purpose:

On September 29, 2006 at 10:00 a.m., the House Science Committee will hold a hearing about the status of a critical weather satellite program, the National Oceanic and Atmospheric Administration's (NOAA) Geostationary Operational Environmental Satellite (GOES) system. NOAA is beginning the process of purchasing the next generation of the GOES system, which has been designated GOES-R. Cost estimates for the system have escalated, and NOAA has already announced the elimination of one new sensor that was to be part of the satellite. The Government Accountability Office (GAO) recently completed a report about GOES-R, "Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs." The GAO report will be officially released at the hearing. (An embargoed copy of the Executive Summary of the report is attached as Appendix I.)

Geostationary satellites maintain a fixed position above the Earth and provide a constant view of weather conditions. NOAA operates a two-satellite geostationary system to provide continuous and complete coverage of the continental Unites States. This system provides vital real-time data for NOAA's weather forecasting and warning operations.

Government satellite programs have a history of technical problems and major cost overruns. Most recently, NOAA and its government partners (the Department of Defense and the National Aeronautics and Space Administration) have experienced massive cost overruns on another weather satellite program, the National Polar-orbiting Operational Environmental Satellite System (NPOESS). In June, government officials testified to the Science Committee that the NPOESS program needs to be completely restructured, resulting in delays, higher costs, and more limited capabilities than were originally planned for the satellite.

The GOES-R program is at a much earlier stage than NPOESS is at this point. NOAA has nearly completed the preliminary design of GOES-R. The GOES-R satellite series is intended to maintain the continuity of weather forecasting data through 2028 and provide the first major technical advance in geostationary instrumentation since 1994. Original estimates for GOES-R placed the total cost at $6.2 billion, but as of May 2006 the program office estimated costs could be as high as $11.4 billion. In an effort to lessen these costs, NOAA is currently looking at options to reduce the scope and capabilities of GOES-R.

The GAO report, requested by the Committee, examines the status of the GOES-R program and reasons for the cost increases and problems to date, and identifies program management actions NOAA should take to ensure past problems with satellite programs are not repeated with GOES-R. GAO identified four major lessons from previous satellite programs and found that, while NOAA has some plans to address those lessons, actions remain for NOAA to fully implement the lessons and decrease the risk of future cost overruns and technical problems.

Witnesses:

Vice Admiral Conrad C. Lautenbacher (ret.), Administrator, National Oceanic and Atmospheric Administration
Mr. David Powner, Director of Information Technology Management Issues, U.S. Government Accountability Office

Background about GOES-R

The GOES-R satellites are designed to maintain a fixed position at high altitude above the Earth and provide a constant view of weather conditions in the United States. They orbit at the same speed as the Earth rotates, and so appear to hover above a set position on the ground. They complement other weather satellites (polar-orbiting satellites) that circle the Earth at low altitude and provide global coverage of weather and climate conditions. NOAA has flown geostationary satellites since 1970.

GOES-R satellites are being built to carry instruments, or sensors, to measure a number of atmospheric features important to real-time detection and tracking of severe weather such as thunderstorms and hurricanes. GOES satellites are also important for NOAA's daily and hourly weather forecasts. Original plans for GOES-R included four satellites, each carrying five sensors, described in detail below. GOES-R will be the first major technical upgrade for NOAA's geostationary satellites since 1994. (New GOES satellites have been launched since 1994, but they have not been more advanced than their predecessors.)

Originally Planned GOES-R Sensors

Original plans for GOES-R, developed in 2003, included three sensors for weather forecasting and two for detecting solar flares that can interfere with communications and other electrical systems. The key sensors for weather data are the Advanced Baseline Imager (ABI) and the Hyperspectral Environmental Suite (HES). ABI will provide images of the earth's surface, atmosphere and cloud cover that help track severe weather and support regular weather forecasts. ABI will provide higher resolution and faster coverage than the current capabilities. For example, current GOES satellites provide updated pictures every 25 minutes and ABI is to provide updated images every five minutes.

HES was supposed to provide significantly advanced "sounder" information compared to capabilities on current satellites. Sounders like HES provide three-dimensional vertical profiles of atmospheric temperature and humidity. These profiles are fundamental information for the computer models used to provide daily weather forecasts. Original GOES-R plans also called for HES to provide images of coastal waters to help scientists monitor events like harmful algal blooms or assist in fisheries management.

Earlier this month, NOAA decided HES was too complicated and the technology was not mature enough to include it on GOES-R. NOAA is currently examining other options to provide sounder capabilities on GOES-R.

The third weather forecasting sensor on GOES-R will be the Geostationary Lightning Mapper (GLM). In the past, the government has flown lightning mappers on polar-satellites for research purposes, but GOES-R will be the first time the U.S. flies a lightning mapper on a geostationary satellite for operational purposes. NOAA expects that the GLM will provide improved capabilities for tracking thunderstorms and severe weather events.

The other two sensors planned for GOES-R are the Space Environmental In-Situ Suite (SEISS) and the Solar Imaging Suite (SIS). Together these sensors will detect solar storms and track dangerous solar flares that come towards the earth. NOAA forecasts and warns about solar storms because the storms can: cause damage to communication satellites, electric transmission lines and electric transformers; interfere in ground-based communications with airline pilots; be fatal to astronauts on space flights and in the International Space Station; and potentially harm airplane passengers flying polar routes.

GOES-R Management, Timeline, and Budget

GOES-R is the first time NOAA is taking on primary responsibility for managing the procurement of a major weather satellite. In the past, NOAA relied on NASA to procure and launch the GOES satellites. For GOES-R, NOAA is responsible for the overall satellite, while NASA will assist in procuring individual instruments.

NOAA expects the current GOES satellites to last at least until 2016. Current plans for GOES-R will launch the first satellite in 2014, leaving two years for calibrating the new satellite before it needs to be fully operational. This timeline is consistent with how NOAA typically schedules geostationary satellite launches and calibration.

NOAA began internal design of and planning for GOES-R in 2003. In October 2005, NOAA awarded three contracts for the preliminary design phase of GOES-R. During this phase of the program, the three private contractors develop detailed technical, schedule and cost plans for the overall GOES-R system based on the original design described above. The preliminary design phase ends in December 2006. Based on work performed during the preliminary design phase, NOAA will issue a Request for Proposals for system acquisition and operations and then will make a final decision on the prime contractor for GOES-R.

However, results thus far from the preliminary design phase indicate that NOAA underestimated the cost and technical complexity of the GOES-R satellites and sensors. The original cost for a series consisting of four satellites and five sensors was estimated at $6.2 billion. However, more recent and more detailed cost estimates indicate that costs would be close to $12 billion. Also, based on preliminary design work, NOAA decided earlier this month that HES was too complicated and the technology was not mature enough to include it on GOES-R. Given the rising cost estimates and technical challenges, NOAA is currently examining options for scaling back the GOES-R program. NOAA is looking at options that include building only two satellites, and removing HES and providing less advanced sounder capabilities.

Originally, NOAA planned to select the prime contractor by July 2007. The process of re-designing the satellite will delay that selection until May 2008.

In addition to selecting a prime contractor, NOAA will also issue contracts for the individual sensors on GOES-R. NOAA has already selected a contractor for building ABI and for SEISS, and expects to select the contractor for SIS in spring 2007. By starting work on key sensors now, NOAA hopes to allow plenty of time to mitigate any technical problems that may occur while developing the equipment.

Lessons Learned from Past Problems with Government Satellites

Government satellite programs have a history of technical problems and major cost overruns. GAO examined four major satellite procurement programs and identified key lessons learned from those procurements that it recommends NOAA apply to the GOES-R procurement.

Lesson #1: Establish Realistic Cost and Schedule Estimates

Many experts have found that satellite acquisition programs tend to produce unrealistically low cost and schedule estimates. Contractors have incentive to come in with low estimates to make their bids more competitive, and agencies have incentive to produce low estimates to make the programs appealing to budget reviewers and the Congress.

For GOES-R, NOAA has commissioned three costs estimates (one by GOES-R officials, one by NOAA's budget office, and one by an independent cost estimating group), but currently has no firm plans for how to reconcile the government and independent life-cycle cost estimates once the program requirements are completed. Thus, GAO recommends NOAA establish a formal process for objectively evaluating and reconciling the government and independent lifecycle cost estimates for the program.

Lesson #2: Ensure Sufficient Technical Readiness of the System's Components Prior to Key Decisions

Satellite programs are technically complex and often experience problems as equipment is being built. To mitigate the technical risk, managers establish key decision points to make sure the technology meets certain requirements before moving on in the program. However, in past programs adequate requirements were not always established for key decision points. For example, for the most problematic sensor in the NPOESS program (VIIRS), a key decision point known as the critical design review proceeded with officials reviewing only a paper design for the sensor. Most experts agree that normally a critical design review should include building a model unit, not just reviewing designs on paper.

NOAA has performed preliminary studies of some of the GOES-R technologies but GAO recommends much more extensive reviews by technical experts before sensors go into production. In particular, GAO is concerned about the Advanced Baseline Imager (ABI). ABI is similar to VIIRS and is based on the same legacy NASA sensor (MODIS). ABI will cost $360 million and has already experienced technical problems that led to cost overruns of $6 million, so far. GAO projects those overruns could reach as high as $23 million if NOAA does not put in place more rigorous technical and management review milestones for ABI.

Lesson #3: Provide Sufficient Management at Government- and Contractor-Levels
Another problem systemic in satellite procurement is poor management. On the government side, this can mean inadequate expertise in systems engineering and project management, inappropriate contractor award fees, inadequate reserve funds, and lack of close oversight of the contractor.

For GOES-R, NOAA plans to increase the number of resident systems engineers and project management experts and to place government staff at each of the contractors' locations to more closely oversee day-to-day program management. Additionally, NOAA intends to structure the award fee process for GOES-R in a manner consistent with recommendations from a recent report by the Department of Commerce Inspector General and other experts.

The GAO report commends NOAA for the management action taken to date, but points out that, especially since GOES-R marks the first time NOAA is taking on a major satellite acquisition by itself, NOAA may need more technical experts than it currently plans to hire.

Lesson #4: Perform Adequate Senior Executive Oversight to Ensure Mission Success
Timely and informed decisions from senior officials are vital to successful satellite programs. GAO and others have stated that the lack of timely decisions by senior management in the NPOESS was a major factor in the large cost overruns and schedule delays for that program. With GOES-R, NOAA has established a council of high-level officials who meet monthly to review the program. GAO recommends that this council closely review the results of all preliminary studies and independent assessments of the program.

Witness Questions:

The witnesses were asked to address the following questions in their testimony.

Vice Admiral Conrad C. Lautenbacher (ret.), Administrator, National Oceanic and Atmospheric Administration

1. What new processes for satellite procurement has NOAA implemented as a result of lessons learned from previous programs, such as the National Polar-orbiting Operational Environmental Satellite System?
2. Do you agree with the following recommendations from the Government Accountability Office (GAO)'s report, "Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs?"
    a. Develop a process to evaluate and reconcile the independent and program cost estimates once final program decisions are made.
    b. Develop a process to validate the level of technical maturity and contractor management procedures achieved on the Advanced Baseline Imager prior to critical design reviews.
    c. Determine the appropriate level of resources needed to adequately track and oversee the GOES-R program.

d. Ensure that the NOAA Program Management Council reviews all preliminary studies and independent assessments on technical maturity of the system and its components so that an informed decision can be made about the level of technical complexity it is taking on when proceeding past key decision milestones.

3. What specific steps have you taken and will you take to address each of GAO's recommendations listed in question two?

Mr. David Powner, Director of Information Technology Management Issues, Government Accountability Office

1. Please outline the major findings and recommendations of your report, "Geostationary Operational Environmental Satellites: Steps Remain in Incorporating Lessons Learned from Other Satellite Programs."
2. Given its current schedule and procedures, what are the greatest risks facing the GOES-R program as it moves ahead?
3. What information should Congress and the public have to ensure the GOES-R program remains on track?

Appendix I: Executive Summary from GAO Report (attached as a PDF)